Brookfield, Missouri
Water Supply Study
City Lake

The primary source of water supply for Brookfield is pumping from West Yellow Creek. The pumping plan is to pump 1500 GPM from the creek into holding ponds. There are 3 of these ponds, each 10-feet deep. Surface areas are 17 acres, 7 acres and 8.5 acres. These ponds are kept full. Because the creek does not flow during dry weather, there is a lake one and one third miles East of the holding ponds. This lake has a small drainage area of 650 acres, too small to supply the lake with enough runoff for an adequate water supply. To be assured of adequate supply during a drought the city pumps from West Yellow Creek into the lake. Two pumps with 1000 GPM pumping capacity each, are used to fill the lake. When the creek does not have enough flow to fill the holding ponds, water is pumped from the lake to the holding ponds at the rate of 1000 gallon per minute.

To make this analysis, stream flow for Locust Creek gage at Linneus, for the 1950's was used. Daily flows were reduced by the ratio of drainage areas. Seven cfs were allowed to pass downstream before pumping began. This is the same ratio to drainage area as was used at Milan. The next 3.34 cfs was used to pump to The Ponds, the next 4.45 cfs was used to pump to the Lake. A minimum reserve of 450 acre-feet was maintained in the lake at all times.

The lake intake is a floating intake. It connects to the raw water piping on a concrete pillar that is roughly 3 feet above the original bottom of the lake. This raw water line passes through the dam to the lake pumping station on the downstream side of the dam. The intake can draw water over a 40 feet range.
Spillway crest is at elevation 800 feet. This is a concrete ogee crest that is level and in good shape.

Following is how the data was derived by control work.

STO-AREA Elevation-Storage and Elevation-Area data were determined from July 2000 survey made by USGS.

Brookfield City Lake

Elevation (feet)	Surface Area (acres)	Volume Storage (ac-ft)	
768	2.2	1.5	
770	6.6	10.5	
772	11.0	27.9	
774	16.5	55.2	
776	23.7	95.3	
778	29.8	149.0	
780	36.8	215.3	
782	43.1	295.6	
784	49.6	387.9	
786	57.1	494.6	
788	65.0	616.7	
790	72.9	754.4	
792	81.8	908.8	
794	90.1	1081.2	
795.8	97.1	1249.7	Water surface 7/12/00
796	98.0	1269.2	
797	102.6	1369.5	
798	107.4	1474.4	
800	117.4	1699.0	
802	125.6	1942.3	
803	130.7	2070.3	Approximate top of dam

LIMITS Brookfield City Lake Max. Pool storage 1699 Ac.Ft.
Minimum Pool storage 55 Ac.Ft.

GENERAL Record period of drought is in the 1950's. Analysis began in January 1951 and ended December 1959.

SEEPAGE Seepage when full was estimated to be 3.5 inches per month and when the pool is near empty seepage is zero.

RAINFALL Rainfall data came from the Brookfield, Mo. rain gage.

RUNOFF This is the runoff into the lake from its drainage area. Monthly runoff volumes in Watershed inches was determined at the Linneus gage on Locust creek. When runoff did not appear reasonable when compared to rainfall it was necessary to examine daily rainfall values for that month. Antecedent moisture was estimated for each rainfall event and adjustments to NRCS runoff curve number was made to arrive at runoff for each rain.

EVAP. Pan evaporation at the Lakeside gaging station was used as a base because it has data for year around evaporation. This data was updated with gage data from stations at Spickard, New Franklin, and Columbia. Depending on the latest data for the station nearest to Milan.

DEMAND This was determined by city records. They use 620,000 Gallon per day, which comes from the holding ponds.

To establish the demand for the lake, an analysis of the holding ponds was made to determine the amount of additional water, that could not be supplied by the creek, needed to keep the holding ponds full. This varied each month and was not a constant.

Holding Pond Runs

1. The first RESOP run for the holding ponds considered inflow to the ponds to be from West Yellow Creek at the rate of 1500 GPM (3.34 cfs). Seven-cfs was allowed to pass downstream to meet in-stream flow needs. The next 3.34-cfs was pumped to the ponds. Pumping was continuous when stream flow was adequate. This run produced spills.

2. Run Two was to eliminate the spills from the ponds. This gave the months and volumes of water that was deficit without the Lake contributing to the supply.

3. Run three added 1000 GPM pumped to the holding ponds. Pumping was continuous and produced spills.

4. Run four eliminated these spills to determine the demand from the lake. The lake was analyzed using this demand.

OTHER This refers to the volume of water pumped from West Yellow Creek to the holding ponds and/or to Brookfield City Lake.

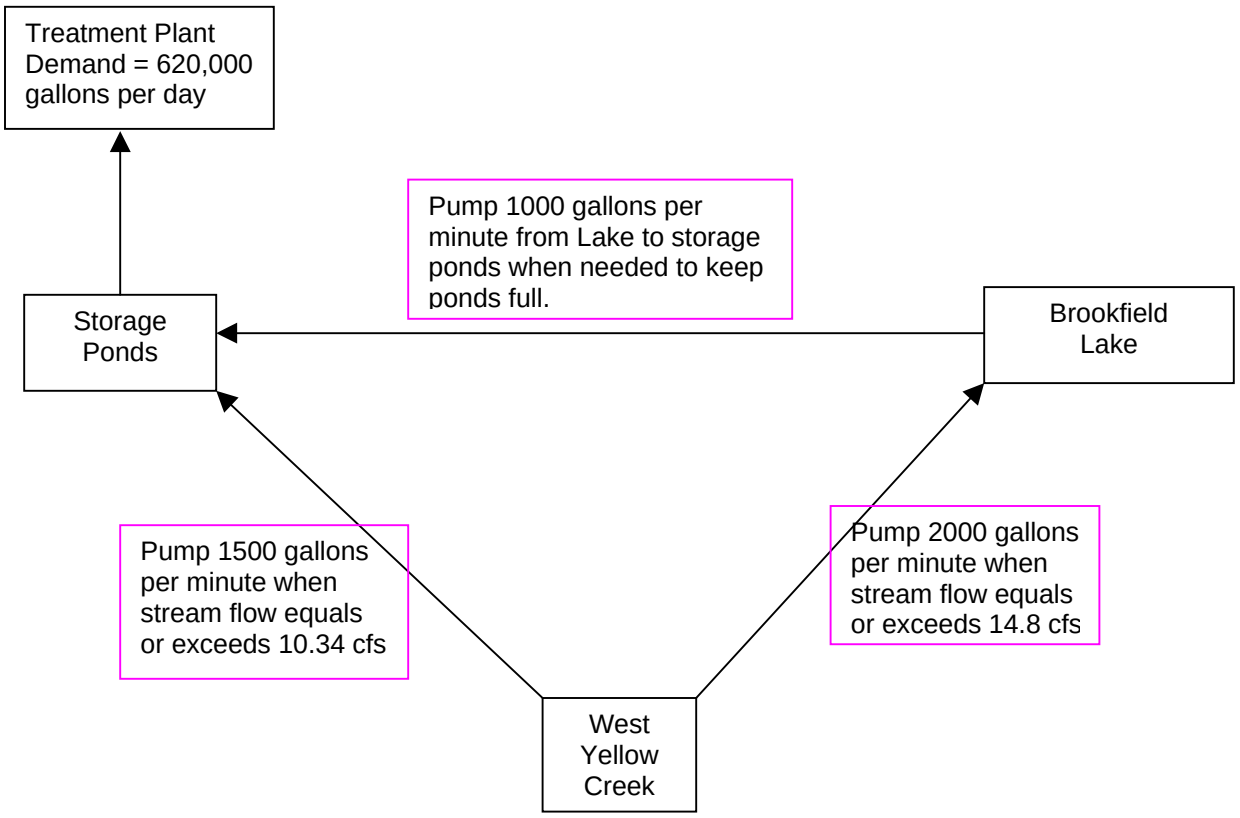
Determination of the volume of water available for pumping was made using daily discharges at the stream gage at Linneus. The drainage area at Linneus is 550 Sq.Mi. and the drainage area for West Yellow Creek at the point of pumping is 159 Sq.Mi. The daily discharge rates at the point of pumping were reduced by a ratio of 159/550. Pumping was only planned for flows above 10.34 cfs, 7 cfs, for in-stream flow

requirements plus 1500 GPM, 3.34 cfs for pumping to the ponds.

To fill the lake, 2000 GPM, 4.45 cfs, was planned after stream flow reached 14.79 cfs. No pumping was used when there was spillage.

BROOKFIELD WATER SUPPLY AND TREATMENT

Following is the flow chart used as a guide for the analysis of Brookfield water supply. West Yellow Creek is the primary source of water supply for Brookfield. The following scenario was used to determine if the water supply would be adequate for the 1950's drought. For this study, pumping from the creek to the holding ponds was considered the first source of water supply, pumping when needed, and if stream flow permitted. If stream flow did not permit pumping, then water was pumped from the lake to meet needs. The objective was to keep the holding ponds to within a foot of the top. As a result, the demand from the lake is not constant each month.



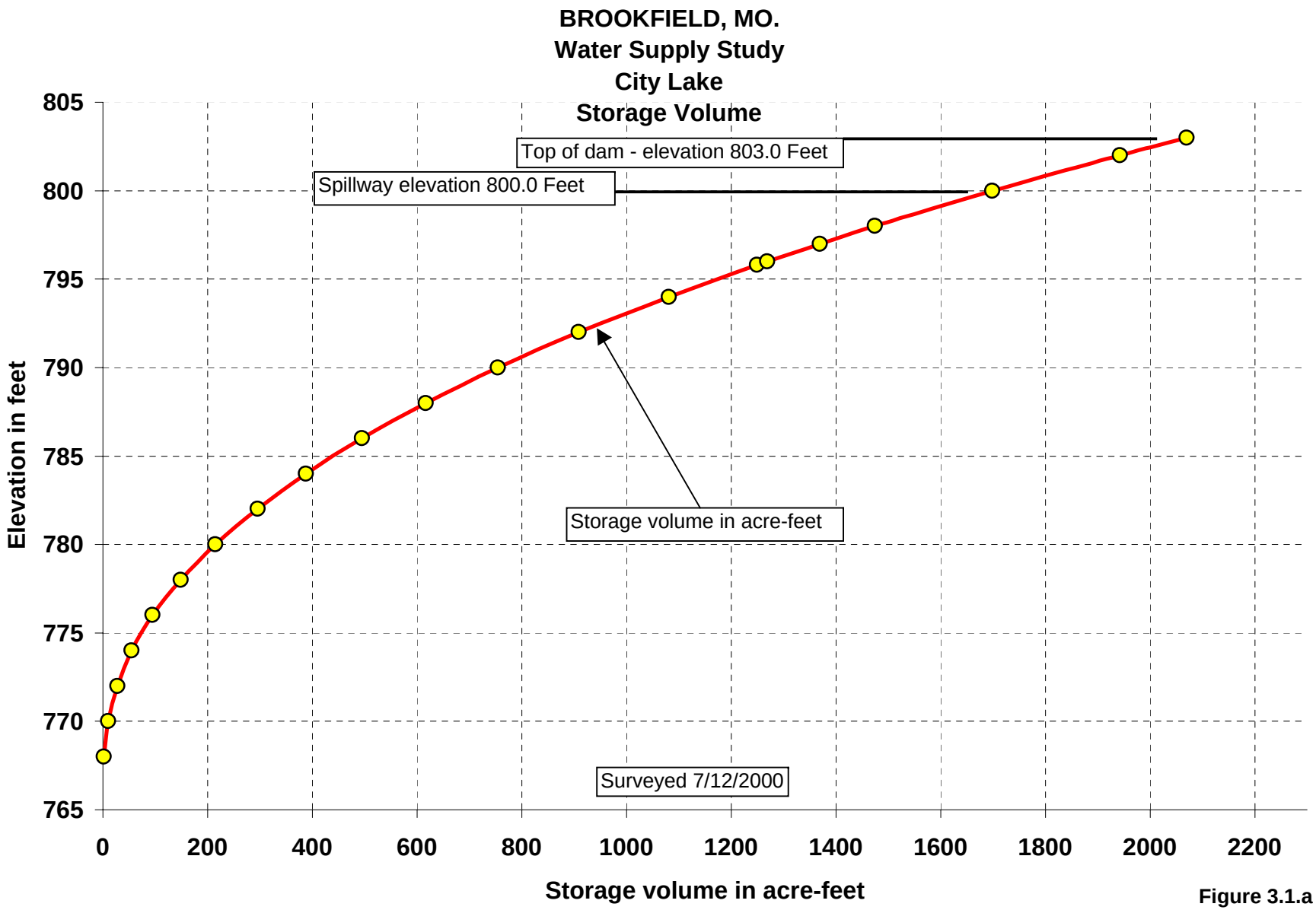

BROOKFIELD, MO.
Water Supply Study
City Lake
Storage Volume
Top of dam - elevation 803.0 Feet
Spillway elevation 800.0 Feet
Storage volume in acre-feet
Surveyed 7/12/2000
Elevation in feet
805
800
795
790
785
780
775
770
765
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
Storage volume in acre-feet

Figure 3.1.a

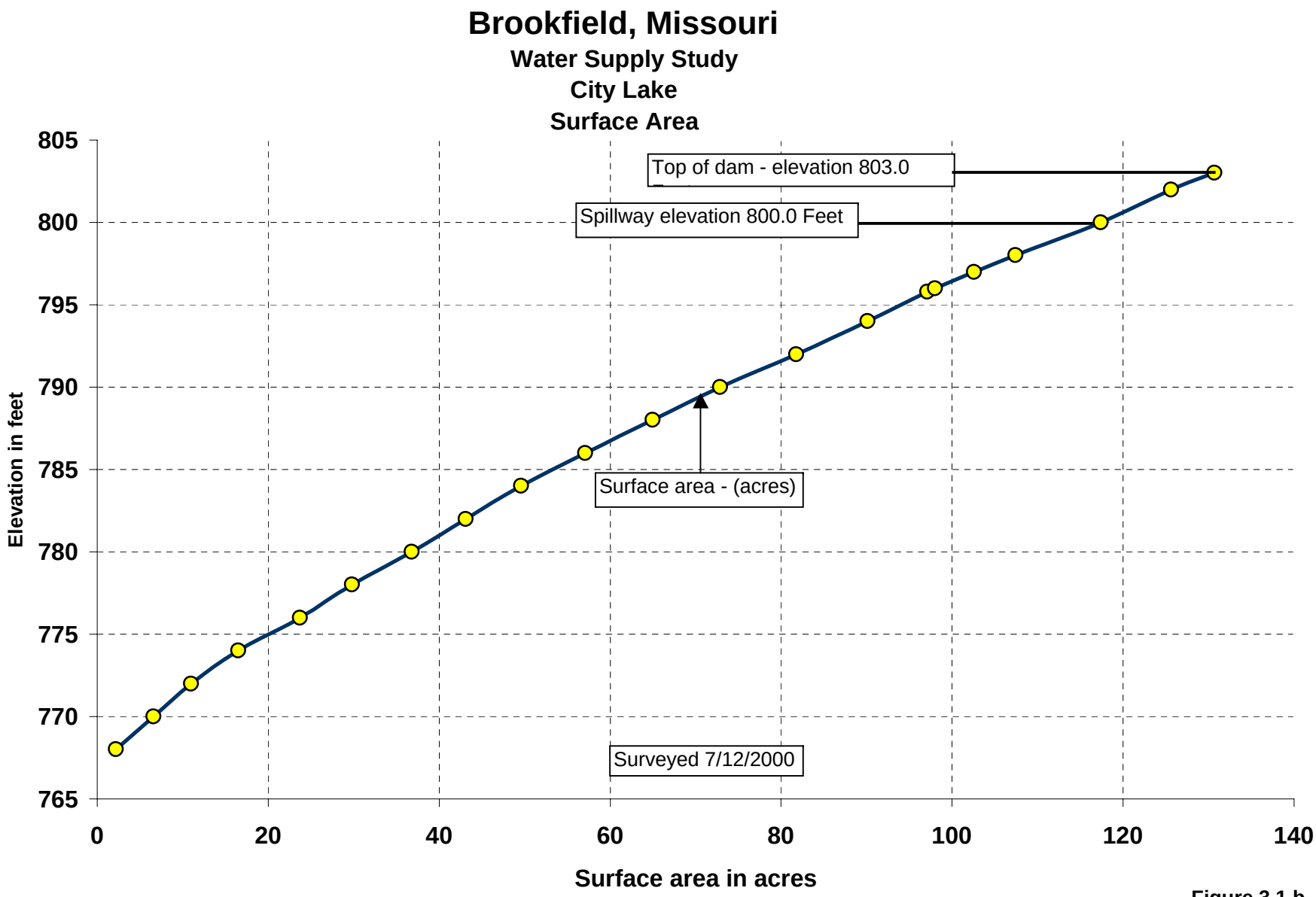

Brookfield, Missouri
Water Supply Study
City Lake
Surface Area
Top of dam - elevation 803.0
Spillway elevation 800.0 Feet
Surface area - (acres)
Surveyed 7/12/2000
Elevation in feet
805
800
795
790
785
780
775
770
765
0
20
40
60
80
100
120
140
Surface area in acres

Figure 3.1.b

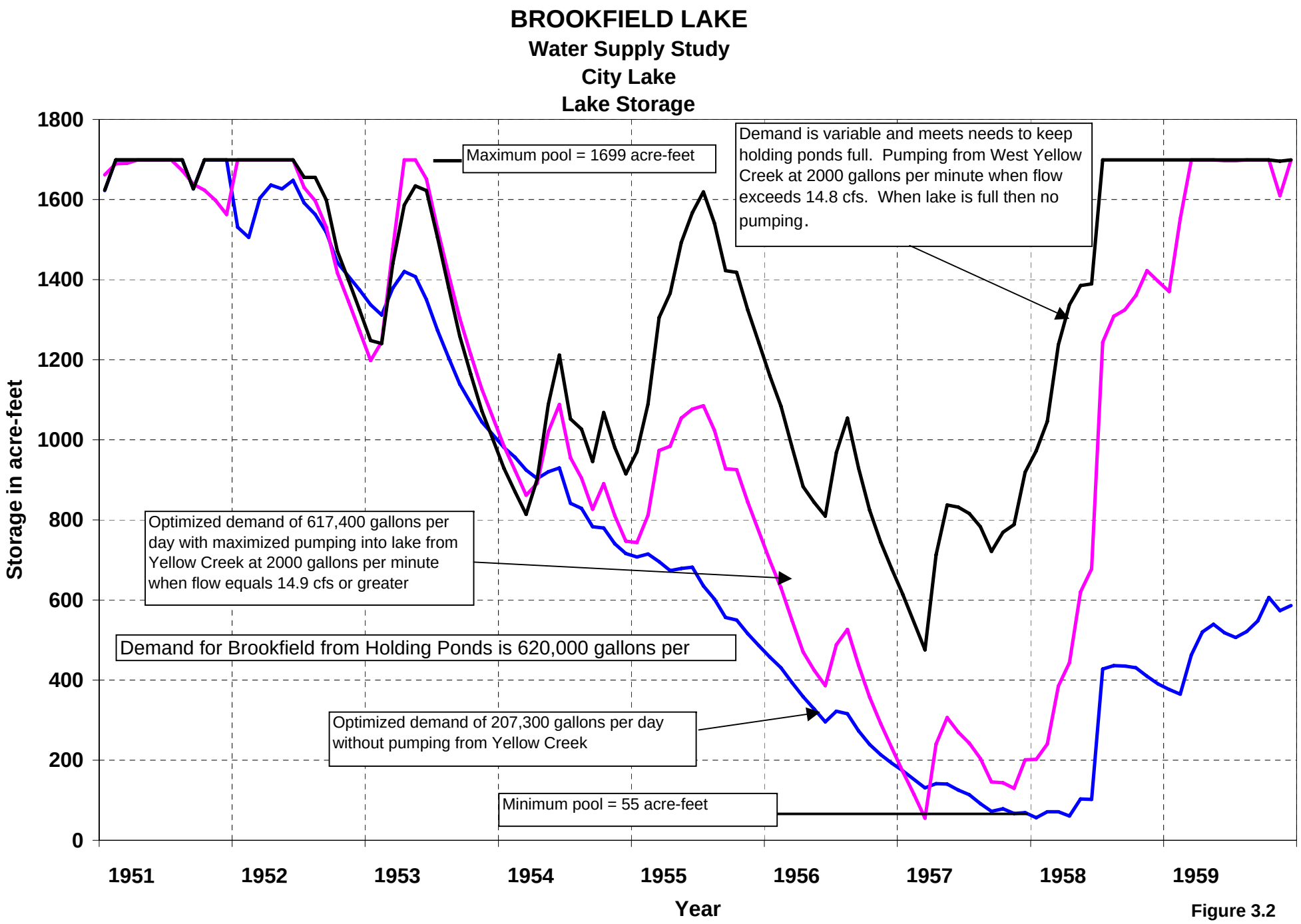

BROOKFIELD LAKE
Water Supply Study
City Lake
Lake Storage
Storage in acre-feet
1800
1600
1400
1200
1000
800
600
400
200
0
1951
1952
1953
1954
1955
1956
1957
1958
1959
Year
Maximum pool = 1699 acre-feet
Demand is variable and meets needs to keep holding ponds full. Pumping from West Yellow Creek at 2000 gallons per minute when flow exceeds 14.8 cfs. When lake is full then no pumping.
Optimized demand of 617,400 gallons per day with maximized pumping into lake from Yellow Creek at 2000 gallons per minute when flow equals 14.9 cfs or greater
Demand for Brookfield from Holding Ponds is 620,000 gallons per
Optimized demand of 207,300 gallons per day without pumping from Yellow Creek
Minimum pool = 55 acre-feet

Figure 3.2

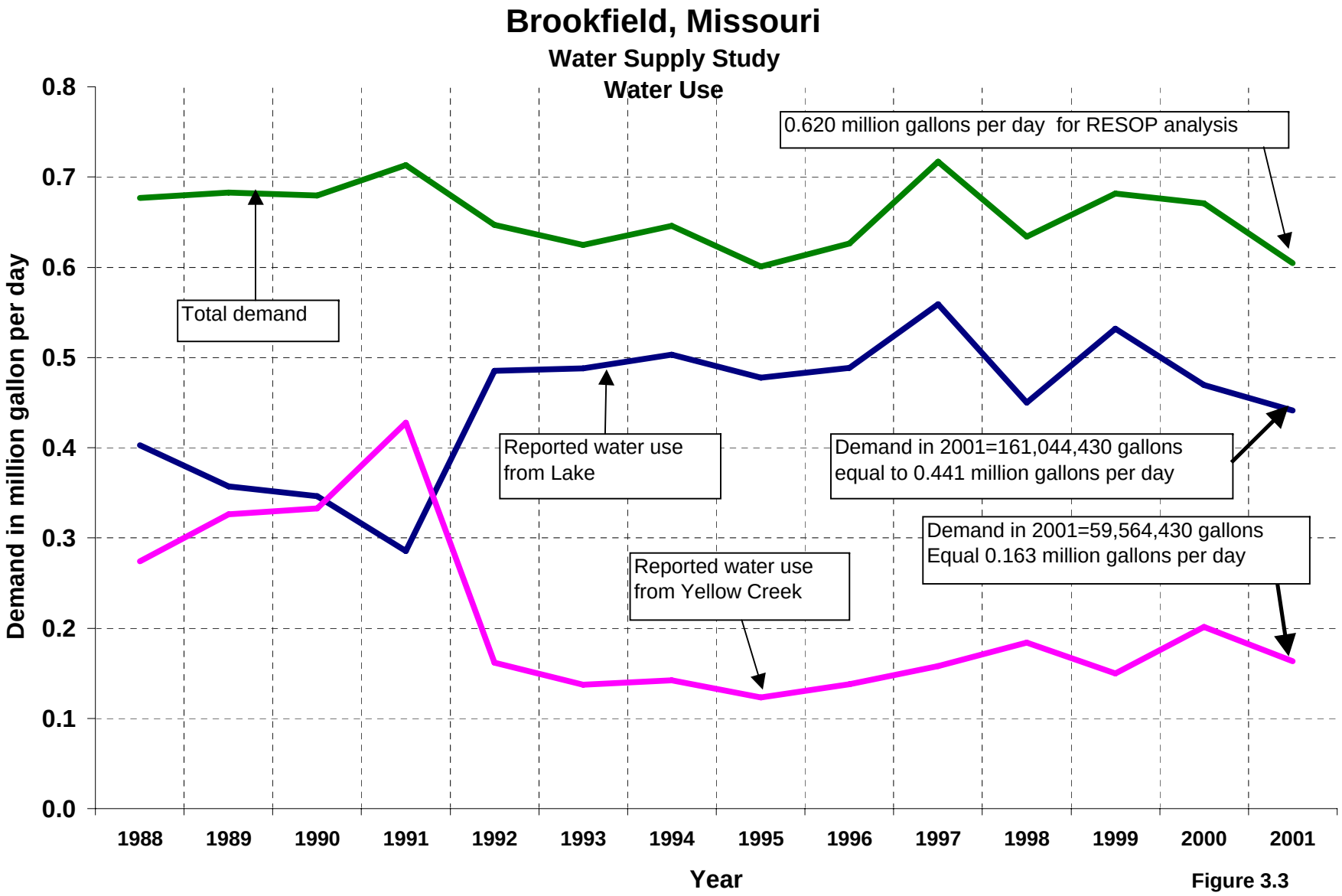
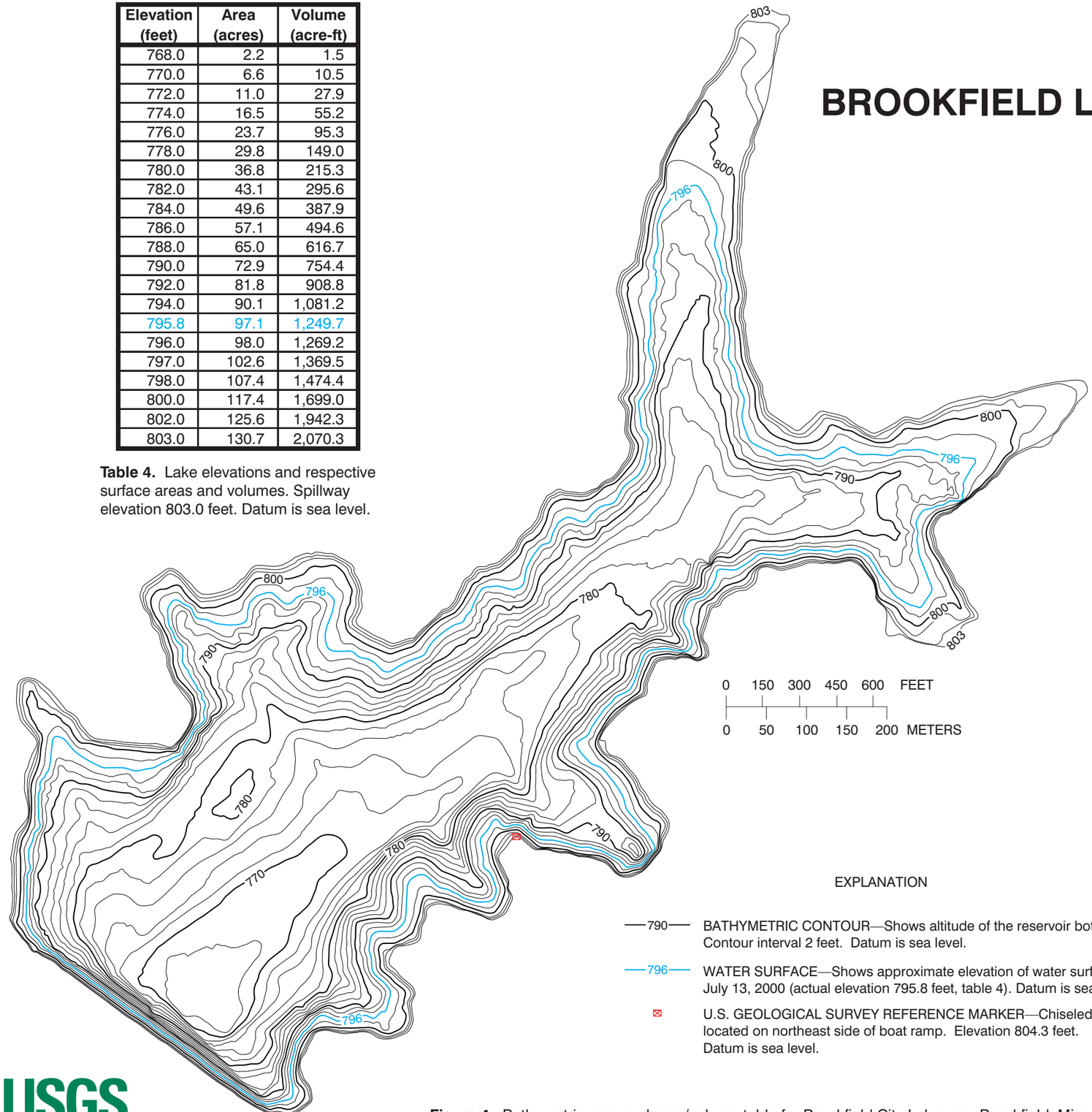

Brookfield, Missouri
Water Supply Study
Water Use
0.620 million gallons per day for RESOP analysis
Total demand
Reported water use from Lake
Demand in 2001=161,044,430 gallons equal to 0.441 million gallons per day
Demand in 2001=59,564,430 gallons Equal 0.163 million gallons per day
Reported water use from Yellow Creek
Demand in million gallon per day
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
Year

Figure 3.3

Elevation (feet)	Area (acres)	Volume (acre-ft)
768.0	2.2	1.5
770.0	6.6	10.5
772.0	11.0	27.9
774.0	16.5	55.2
776.0	23.7	95.3
778.0	29.8	149.0
780.0	36.8	215.3
782.0	43.1	295.6
784.0	49.6	387.9
786.0	57.1	494.6
788.0	65.0	616.7
790.0	72.9	754.4
792.0	81.8	908.8
794.0	90.1	1,081.2
795.8	97.1	1,249.7
796.0	98.0	1,269.2
797.0	102.6	1,369.5
798.0	107.4	1,474.4
800.0	117.4	1,699.0
802.0	125.6	1,942.3
803.0	130.7	2,070.3

Table 4. Lake elevations and respective surface areas and volumes. Spillway elevation 803.0 feet. Datum is sea level.

BROOKFIELD LAKE



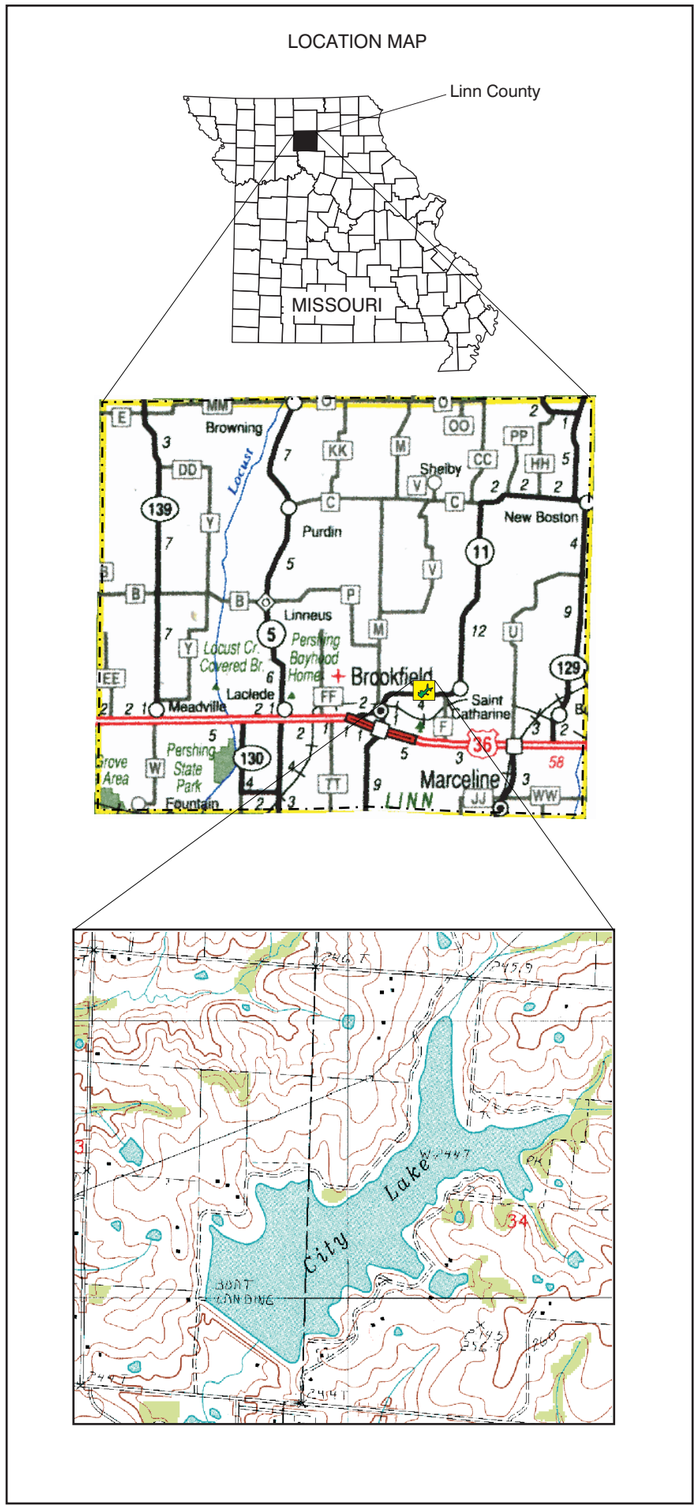


Figure 4. Bathymetric map and area/volume table for Brookfield City Lake near Brookfield, Missouri.

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